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# A Significant Role of Innovation and Green Technology in Sustainable Development of Entrepreneurship

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**ABSTRACT:** In face of growing concern related to climate change, green technology entrepreneurs are critically needed to develop the businesses and ideas behind climate mitigation in developing countries - but they frequently collide with challenges endemic to such environments. The purpose of this study is to shed light on the role that connections can play in helping green technology entrepreneurs innovate and scale up in developing countries, so as to inform the design of new public sector programs. Green technology entrepreneurs in developing countries need connection platforms for people, ideas, business models, transactions, as well as membership of expert communities. This study shows how cheaper, quicker, and more efficient connections can be created among stakeholders of green technology innovation in developing countries. This is done through drawing insights from a variety of public and private programs that seek to promote connections between entrepreneurs in green technology and other sectors.

**KEYWORDS:** sustainable, innovation, green technology, entrepreneurship, significant, development, business, expert, communities

## I. INTRODUCTION

Sustainability has never been more of a priority in business planning, management and operations — or more likely to reap measurable results. Yes, there is the imperative to reduce carbon footprint and our impact on the environment. And in many regions there are related government regulations and green incentives as well. But in addition, the ways in which IoT and connectivity can improve business efficiency and reduce costs mean that investing in green technology is not just the right thing to do; it makes good business sense as well. That said, you may have questions about the ROI of green technology and clean tech investments.[1,2]

When and how should your business invest in green tech and more sustainable practices to meet your organization's unique needs? Will that investment pay off in terms of metrics such as efficiency and cost-savings, competitive differentiation, customer loyalty, investor relations and business growth? In this blog post, we'll discuss some of the most significant green trends influencing modern business practices, as well as the numerous benefits of investing in technology-driven sustainability for your organization.

Modern businesses have both external and internal pressures motivating decision makers to adopt and develop green technologies. At the same time, industry-wide green trends are also swaying customer expectations and market demands for responsible ecological practices in B2C and B2B organizations alike.[3,4]

As a result, sustainability and green technology have become essential differentiators. To stay competitive, and for public companies to lure investors, today organizations need to develop strategies that embrace the innovations that have come out of green trends in business, such as:

- Energy consumption management: Industries like manufacturing, construction, mining and agriculture are reconsidering their often high levels of energy consumption. Modern businesses are adopting distributed smart grid and energy monitoring solutions that allow them to easily gather data on their energy usage and find ways to minimize their environmental impact and ultimately cut costs.
- Renewable energy: One of the most prevalent trends in green technology is the push toward adopting renewable energy and the smart grid. Businesses want to power machinery, entire facilities and even whole transportation fleets using renewable sources like solar, hydropower, biomass and wind. This trend spans

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geographies and industries — in fact, renewables accounted for 90% of power capacity expansions in 2021 worldwide.

- Sustainable automation: Sustainable automation has become a widespread priority across commercial and public transportation, as well as manufacturing. Organizations are gaining visibility into the type of energy sources they use, how much energy they consume and the financial and environmental consequences.
- Green transportation: From Teslas to electric and hydro-powered buses, sustainable electric vehicle technology has advanced significantly in recent years, making green transportation a much more feasible and worthwhile goal for many consumers and businesses.[5,6]
- Remote connectivity and management: One of the most significant ways in which technology supports sustainability is in putting IoT to work at distributed sites across farming acreage, oil fields, industrial sites and smart cities. IoT enables environmental monitoring in remote areas, as well as the ability to gain visibility and control into any operations anywhere. The result is better management and business efficiency - such as reduced water usage - as well as the ability to prevent unnecessary service trips to remote areas and thwart environmental disasters.

Like any kind of organizational transformation, adopting green business practices requires leaders to consider what needs to change about their technology, processes, culture and in-house skills at the same time.

Understanding your organization's specific needs and use cases is an essential first step to determining whether the green technologies you're considering are worth the investment. What is green technology and its benefits, and how can you deliver the most value based on your partners' or customers' motivations and needs? Taking that approach can help you determine the green tech investments that would benefit your business the most.[7,8]

The incentives to invest in green tech may start with concerns about environmental risk factors, impact on the environment, and a desire to avoid negative public relations. And it's important to note that sustainability initiatives deliver significant environmental and public health benefits that are strong incentives on their own.

But today, enterprises and cities are also seeing the ROI of environmental practices in business. These include operational efficiency, cost savings and government incentives, as well as favorable Environment, Social and Corporate Governance (ESG) ratings. Advancements in green technology have delivered tangible value for everything from industrial facilities to retail to supply chain management.[9,10]

Strategic green tech investments give organizations access to benefits such as:

- Increased safety and productivity: Environmental pollution can create hazardous environments, especially in industrial sectors like manufacturing and construction. With green technology like environmental monitoring, businesses can quickly pinpoint and address environmental factors that affect safety, preventing malfunctioning equipment, harmful pollution and other hazards.
- Optimized resource consumption: Businesses and the supply chains they depend on are more widespread than ever, which can make it difficult to centralize resource tracking. By investing in Internet of Things (IoT)-enabled monitoring solutions, businesses can gather the data they need in real time, whether tracking fuel consumption for transportation fleets or raw material waste at an agricultural or mining site.
- Sustainable infrastructure development: The growing interest in developing smart, sustainable cities has already laid a foundation for more widespread sustainable infrastructure. As this continues, the ability to coordinate traffic, reduce emissions and respond to emergencies faster will only improve, reaping rewards that benefit everyone.
- Circular economy growth: Investing in green technology also allows businesses to scale their sustainable practices beyond their individual goals or metrics, contributing to circular economies that can prevent or eliminate waste. With increased access to timely data insights, organizations can further eliminate waste and promote resource sharing, reuse and recycling between commercial partners as well as their larger community.

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So, what are green business practices that your organization can adopt, improve or work toward? And how will that help your company both contribute to and benefit from a more sustainable future? To effectively implement technology for a green future, organizations need to continually ask and address these questions as they progress toward more efficient, less wasteful operations.

With the right strategy, organizations can adopt solutions like IoT-enabled green technology and 5G-enabled devices to accelerate and scale their sustainability initiatives across all areas of their business.[11,12]

## II. DISCUSSION

Today, technology that will help the environment can also help businesses, nonprofits and public organizations meet key goals — improving efficiency, increasing safety and reducing operating costs. Here are some examples of green technology investments that can save your business money.

With IoT devices, organizations can implement environmental monitoring that allows them to measure and gather data from remote sites. Businesses can embed connected sensors in everything from industrial machines to irrigation systems and tanks to oil rigs and factory temperature control systems.

By deploying IoT-based solutions at remote sites, organizations can have an unprecedented level of access and insight into the state of their industrial operations. And with ever-improving edge computing capabilities, businesses can stay responsive to environmental conditions that can threaten safety, damage equipment or decrease productivity:

- Use connected devices like sensors to gather and transmit data from remote sites
- Monitor properties like temperature, moisture, air quality, soil quality, leaks and water levels
- Integrate IoT-based solutions into centralized systems to set up system shut-off or repair, improving maintenance and accelerating resolutions to unplanned downtime

Improving supply chain performance is another significant cost-saving benefit of adopting IoT-enabled green technology. Businesses can implement scalable IoT platforms that reliably track asset and inventory location and condition, providing real-time updates that can help prevent equipment failures, asset loss or poor supply chain management:

- Integrate GPS location capabilities into products, equipment and transportation for more accurate asset tracking and monitoring
- Improve quality control and efficiency for production lines, distribution processes and transportation routes
- Enhance predictive maintenance based on patterns identified from supply chain data collection over time

In addition to improving environmental conditions and supply chain performance, using IoT devices at remote sites also facilitates the automation of repetitive industrial operations. And with edge computing solutions, organizations can deploy artificial intelligence/machine learning (AI/ML) applications.[13,14]

AI/ML applications can deliver analytics that support intelligent, responsive operational technology (OT) management that adjusts process automation in response to changing conditions at industrial sites:

- Automate recurring or complicated processes for industrial, agricultural, transportation and other use cases
- Use remote monitoring and edge computing solutions to develop intelligent automation to improve efficiency, increase safety and cut operating costs
- Minimize the long-term risk of injury, equipment failures and resource waste with autonomous vehicles, machines and mechanical processes

Strategizing and promoting green business practices in your organization is more than a trend or way to win a specific customer or market segment. Making an investment in green technology allows organizations to significantly reduce resource consumption, eliminate waste, and improve inefficient or unsafe operations that have costly outcomes — from

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worker downtime to poor public relations.

Altogether, implementing these changes with scalable, flexible technology solutions can help organizations of any size to save money while contributing to a healthier future that benefits everyone. [15]

Small and medium-sized enterprises (SMEs) are the backbone of most of the country's economies by contributing extensively to GDP growth and providing high levels of employment. Successful enterprises are often driven by dedicated and passionate entrepreneurs who identify, construct and seize chances to capitalize them through business. Hence, entrepreneurship effects in innovation along with social and sustained economic development. Green entrepreneurs deliver the source for beginning and sustaining a green economy by serving green products and services, presenting greener production techniques, enhancing demand for them, and building green jobs.

The concept of green entrepreneur rises from environmental concerns such as global warming, pollutions, scarcity of natural resources, ozone layer depletion, climate change and other disaster caused by the disruption in the ecosystem. Due to this growing awareness of environmental knowledge, consumers are becoming more receptive towards an eco-friendly or green product. So this inclination of the consumers leads towards the development of the green market. The green market is an emerging market, which fetches ample chances in every field such as green design, green supply chain, green production, and many more.

Change is a very common occurrence which sometimes occurs in a cyclic manner or maybe sometimes in random order. In the same method, the customers' needs, wants, demands, tests & preferences are also varying. This change is not for a specific product category but it exists in every product segmentation. There are various reasons for these behavioural changes like an increase in consumers' household income, environmental awareness or maybe because of change in VALS (values, attitude and Lifestyles). This change in consumer behaviour generates a new market opportunity. So to grab this market opportunity, the firms also need to implement some changes like new product development, product redesign or changes in the marketing policies etc. The companies, implementing green practices are also getting profitability in these business operations. Among all these expansions certain models are coming in the field of management such as green marketing, green supply chain management (GSCM), waste management, reverse logistics, etc. which not only achieves the requirements of the consumers but also contribute promise about the green and clean environment.[16,17]

Natural environmental concerns are gradually becoming a fundamental part of the business in every passing day. So, the business units are adopting different business strategies due to this environmental consciousness. This is the reason behind the concept of green marketing, which is taking place slowly but steadily in the market. This can be considered as an opportunity for those entrepreneurs, who rely on ecological redesigning and innovation of their product. It is the perfect phase for those entrepreneurs who want to be a part of this developing green market.

An entrepreneur is one who reforms and transforms the pattern of production by developing innovation or, more generally, an untested technological process of producing a new commodity or producing the one in a new way, originating a new source of supply of materials or new outlet for products, by establishing a new industry. The inclination of the customers' buying behaviour towards eco-friendly product or services creates a space for the green entrepreneur. The term "Green entrepreneur" is the combination of entrepreneurship and the environment. The green entrepreneur is the one, who cultivates green business with the help of green practices. A green entrepreneur consciously addresses an environmental or social problem/need through the understanding of entrepreneurial ideas. They penetrate the market by swapping conventional or traditional products. The objective of the green entrepreneur is not only serving the customer with their green products or services but also makes people aware of the green ecosystem. So the thought for the "green entrepreneurship" originates from the combination of the main features of the entrepreneurship itself – innovation, risk, a brand new business idea, and the social and ecological engagement of those who do business.

In recent days, green entrepreneurs play a very important role in the economic development of the country and also treated as the driving force towards the change of consumer behaviour and also esteemed for launching, innovating, implementing and emerging new thoughts and for their rapid response to these changes. Indeed, there is a crucial

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variance between the way of looking at green entrepreneurship in developed countries and developing countries. Developed countries and international organizations like the World Bank, UNCTAD, OECD, UNIDO, WTO and FAO – incline to put maximum prominence on market opportunities and on the term 'green', while developing countries tend to emphasis more on market needs and on the term 'entrepreneurship'.

From a development perspective "Green entrepreneurship" is a progressively appropriate phenomenon, which is still largely under-researched. While global inequality and growing unemployment pose major challenges to policymakers, the emerging effects of climate change and the rapid loss of biodiversity together with the widespread destruction of wildlife and natural habitats, composite the susceptibility of already burdened social groups and ecosystems. Green entrepreneurship also plays a significant role in job creation. Moreover, technological advancement and variation are extensively influenced by the nature of innovation and its determinants. The recent advance of the globalization of economic procedures has drastically altered the outdated approaches used by enterprises to innovate. Though remarkable advances have been made with environmental accounting and reporting as well as with technological research and implementation, the gap towards sustainability is still significant.[18,19]

So the understanding of pre-condition for the formation of "green innovation" is very crucial along with its triggers and barriers. Systemic alteration is desirable to substitute progress in accounting, economics, and legal frameworks. According to a survey of Accenture (UN Global Compact-Accenture, 2010), sustainability has become a principal worldwide component of corporate business strategies and highly relevant for the future of their businesses. But the global evolution to a green economy is only at the beginning, which is very challenging for the earth to wait. In the next decades, there will be rapid growth in industrialization global population and economic development. Resources are inadequate and we must meet the requirements of people. Green entrepreneurship is the only path to deliver on their commitments to provide efficient and safe operations in an environmentally and socially responsible way.

## III. RESULTS

Even with the steep dip in greenhouse gas emissions during the COVID-19 lockdowns, last year saw record-breaking temperatures around the globe and another surge in climate-related disasters. Despite growing efforts from individuals, business and governments to allay the trends, true sustainability seems to remain a distant goal. However, this shortfall is not a cause solely for despair, but also represents a prime business opportunity for companies across industries and geographies. Some businesses can clearly see the financial incentives of genuinely participating in the generational transition to an entirely new way of powering the world. Harnessing change has always been a root source of wealth creation; with an existential need for innovation, a new phase of wealth creation stands before us: "the green rush."[20,21]

To better understand these dynamics and the scale of the opportunities available, our Center for the Future of Work partnered with MindForce Research to survey 1,000 C-suite and VP-level business leaders across North America and Europe in the midst of the pandemic. More broadly, the study's main findings found the following:

- Europe outpaces the US in green measures. Businesses in Europe are more apt to increase sustainability spending than those in the US.
- Sustainability investments are linked to business gains. A majority of respondents globally expect such investments to increase sales and improve brand reputation, not merely satisfy regulations.
- Technology investment is key to combating climate change. A strong majority of study respondents list environmental sensors/Internet of Things (IoT) as important or very important to meeting their sustainability goals, with smart grids and artificial intelligence (AI) tied for second place.
- Emerging tech can catalyze current sustainability endeavors. Well-established sustainability approaches such as eco-friendly lighting and renewable energy are popular, but newer tech like AI and analytics could supercharge proven techniques — for example, by making energy audits easier and more valuable to conduct.

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- ROI and senior-leader commitment are top concerns and will require a renewed look at sustainability strategies. As usual, these are cited as big sticking points for realizing sustainability goals.

- Underutilized sustainability initiatives that could result in quick wins are readily available. Low-budget but high-impact practices, such as reducing business travel expenses (post-pandemic) and buying refurbished electronics, could gain support needed for more sustainability investment. Indeed, the pandemic has been an inflection point for increased work from home (WFH).

Businesses should regard green initiatives not as "red" — a cost on the balance sheet — but as "green," a money-making opportunity. There is already a surge of climate tech startups, and by 2030, the investment in green-business startups and corporate innovation is projected to grow to $3.4 trillion.[22]

When the cutting-edge technologies listed above are combined with widely used approaches to reducing the carbon footprint, they could turn tried-and-true approaches into game-changers that will curb climate change. For example:

- Eco-friendly lighting in facilities. Over 60% of respondents use eco-friendly lighting already. By adding IoT technology to the mix, businesses can further enhance their corporate carbon reduction — while lowering maintenance costs.

- Using renewable energy. Pairing investments in renewables with smart grid technologies alters the entire marketplace for energy production. The widespread adoption of renewable energy and smart grid technology by large corporate entities could make all companies "power companies." New revenue streams emerge in such a scenario, along with new needs to manage and optimize power generating operations. The smart grid technology market is projected to grow from $20 billion to $61 billion between 2017 and 2023.

- Conducting regular energy audits. With commercial buildings in the US wasting nearly one-third of the energy they use, fixing this problem provides a great opportunity for sustainability at scale. Energy audits are widespread, with about half our survey respondents reporting they conduct them at their companies. Infusing AI into these audits changes a cumbersome and time-intensive process into a powerful tool for companies to continuously monitor their energy use to identify real-time opportunities for improvement — a good example of the convergence among IoT, AI and smart grids.

A few other quick wins for sustainable practice include:

- Encouraging WFH and less business travel. The pandemic turbocharged these trends, with Zoom meetings and virtual reality technology becoming the new norm virtually overnight. While we likely won't return to the old normal, it remains to be seen the roles that remote work and teleconferencing (and related connectivity technologies) will play going forward. Companies can encourage WFH as a means of reducing the environmental impact of business operations.

- Switching to EV fleets. The "cool factor" of electric vehicles aside, their mundane commercial uses like shipping or public transportation stand to make a significant impact. In addition to lowering greenhouse gases, such a transformation could also impact the consumer market for EVs and usher in an entirely new ecosystem of electrified homes.

- Buying refurbished electronics. Despite the immense amount of waste generated by electronics, only 17% of respondents have implemented programs to buy refurbished electronics for their companies. In addition to the reduced environmental impact of buying refurbished goods, the practice is a proven job creator.[23,24]

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It's easy to feel paralyzed by the sheer magnitude of the sustainability problem. The following recommendations should provide leaders with guidance and specific tasks to push past the inertia and maximize the value of innovations sparked by the green rush.

- Establish a stakeholder map. Green business transformation can impact stakeholders both internal and external, directly or indirectly. Mapping the relationships before implementation can facilitate stakeholder buy-in at all levels.
- Commit to dedicated space for sustainability. Businesses can establish credibility and consistency for their programs by dedicating specific resources in budget, full-time staff, time and portfolio considerations, and by committing to fully fund mitigation programs.
- Embrace the constraints of climate change. While some resistance to sweeping change is inevitable, it's key to focus an organization's energy on the creative problem-solving that sustainable practices require along with lowering carbon footprints.
- Let discovery drive growth. ln the face of ROI uncertainty, leaders should take a discovery-driven growth approach in which teams have the leeway to adapt business models in an agile manner, using feedback from experimentation and data.
- Reverse engineer your endpoint. Start with a bold vision of a radically improved sustainable future for the organization, and reverse-engineer the steps required to make that a reality. By doing so, the team can break free of limitations around current business models or service offerings to imagine what's next.

## IV. CONCLUSIONS

The Green Economy and entrepreneurship is an alternative vision for growth and development; one that can generate economic development and improvements in people's lives in ways consistent with advancing also environmental and social well-being. One significant component of a green economy strategy is to promote the development and adoption of sustainable technologies. The overall objective of this article is to discuss a number of challenges encountered when pursuing sustainable technological change, and that need to be properly understood by policy makers and professionals at different levels in society. We also identify some avenues for future research. The discussions center on five challenges: (a) dealing with diffuse – and ever more global – environmental risks; (b) achieving radical and not just incremental sustainable technological change; (c) green capitalism and the uncertain business-as-usual scenario; (d) the role of the state and designing appropriate policy mixes; and (e) dealing with distributional concerns and impacts.[25,26]

The green economy and entrepreneurship transition should also benefit from research that involves various impact evaluations, including methodological innovation in evaluation studies. This concerns evaluations of the impacts of important baseline trends, e.g., digitalization and automation, globalization versus nationalization, etc.[27], on environmental and distributional outcomes but also on the prospects for green innovation collaborations and various circular economy-inspired business models. Such evaluations could be particularly relevant for understanding possible future pathways for the greening – and de-carbonization – of key process industries. Clearly, there is also need for improved evaluations of policy instruments and combinations of policies. With an increased emphasis on the role of technology-specific policies, such evaluations are far from straightforward. They must consider the different policies' roles in the innovation systems, and address important interaction effects; any evaluation must also acknowledge the policy learning taking place over time.[28]

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